

REMARKS

Applicants acknowledge receipt of the Examiner's Office Action dated April 29, 2004. Claims 1-10 were pending at the time. Claims 1-10 were rejected. Specifically, claims 1-2, and 7-10 were rejected under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 5,476,817 issued to Mautz et al. ("Mautz"). Claims 1, 3, 5, and 7-9 were rejected under 35 U.S.C. § 102 as anticipated by U.S. Patent No. 6,410,417 issued to Tsai et al. ("Tsai"). Lastly, claims 3-6 were rejected under 35 U.S.C. § 103 as being unpatentable over Mautz in view of Tsai. In light of the foregoing amendments and following remarks, Applicants respectfully request the Examiner's reconsideration and reexamination of all pending claims.

Claims 1-2, and 7-10 were rejected under 35 U.S.C. § 102 as being anticipated by Mautz. Applicants have amended claim 1 to incorporate the limitations contained in original claim 10. Independent claim 1 now recites:

1. (Currently Amended) A method comprising:
 - forming a tungsten plug in a dielectric layer;
 - forming an electrically conductive interconnect line on the dielectric layer after formation of the tungsten plug, wherein the tungsten plug is electrically connected to the electrically conductive interconnect line;
 - contacting the electrically conductive interconnect line with liquid water after formation of the electrically conductive interconnect line;
 - contacting the electrically conductive interconnect line with a solution to remove residual polymer after the electrically conductive interconnect line is contacted with the liquid water;
 - wherein the electrically conductive interconnect line is contacted with the liquid water for less than 120 minutes.

In rejecting original claim 10, the Office Action alleges that in Mautz there may be a solution to remove residual polymers after contacting the interconnect with water, citing column 6, lines 25-30, lines 45-62; column 7, lines 1-16 in support thereof. Applicants submit it improper to reject claim 10 (now included in claim 1) under 35 U.S.C. § 102

because a prior reference may teach a claim limitation. Notwithstanding, Applicants have performed a word search for the term “polymer” in Mautz. This word search has uncovered only one use of the word polymer. Specifically column 9, line 56-58 of Mautz states:

As a result of the plasma etching process, organic masking layers and other polymer films incorporating mobile ions are consumed, releasing mobile ions in the plasma.

Clearly, the above-quoted section of Mautz does not teach or fairly suggest “contacting an electrically conductive interconnect line with a solution to remove residual polymer” as set forth in amended claim 1 either alone or in combination with the remaining limitations of claim 1. Lastly, Applicants have reviewed column 6, lines 25-30, lines 45-62; and column 7, lines 1-16 cited in the office action and can find no teaching or fair suggestion of “contacting an electrically conductive interconnect line with a solution to remove residual polymer” either alone or in combination with the remaining limitations of independent claim 1. Column 6, lines 25-30 discuss the exposure time to the etching solution. Column 6, lines 45-62 describes a step of rinsing the substrate, wherein the step may include an intermediate solvent rinse a deionized water rinse. Column 6, lines 25-30 does not teach or fairly suggest contacting the electrically conductive interconnect line with a solution to remove residual polymer either alone or in combination with the remaining limitations of independent claim 1. Lastly, column 7, lines 1-16 describe an intermediate solvent rinse followed by a deionized water rinse much like column 6, lines 45-62. Again, column 7, lines 1-16 fails to teach or fairly suggest contacting an electrically conductive interconnect line with a solution to remove residual polymer either alone or in combination with the other limitations of claim 1. Accordingly, Applicants submit that independent claim 1 is patentably distinguishable over Mautz.

The remaining pending claims 2-9 depend from independent claim 1. Insofar as independent claim 1 has been shown to be patentably distinguishable over Mautz, it follows that dependent claims 2-9 are likewise patentably distinguishable.

Claims 1, 3, 5, and 7-9 were rejected under 35 U.S.C. § 102 as being anticipated by Tsai. Applicants have amended independent claim 1 so that it now recites the act of contacting the electrically conductive interconnect line with liquid water. Applicants submit that Tsai does not teach or fairly suggest this limitation either alone or in combination with the other limitations of independent claim 1. It is noted that Tsai teaches in column 3, lines 14-27:

After the aluminum layer 110 has been etched, the remaining photoresist blocks 112 are removed. Preferably, the photoresist blocks 112 are removed in an asher. It has been determined by the inventors that by eliminating the use of oxygen plasma or using a low oxygen flow plasma mixed with other gases like water plasma, the amount of wafer charging can be reduced and the tungsten may be protected from erosion.

Specifically, using a TCP 9600 metal etcher with an in-situ DSQ asher, the preferred recipe is 1000 mT of pressure, 1000 watts power, 50 sccm of oxygen, 400 sccm of water vapor, at 225 degrees Celsius, for 120 seconds. Although the ratio of oxygen to water vapor may vary, it has been determined that the ratio of oxygen to water vapor should not exceed 1:1.


Although Tsai teaches using a low oxygen flow plasma mixed with other gases like water plasma in an asher to remove photoresist blocks, the above-quoted section of Tsai fails to teach contacting an electrically conductive interconnect line with liquid water either alone or in combination with the remaining limitations of independent claim 1. Further, it is noted that at the temperatures at which the asher is described to operate in Tsai, water is not applied to electrically conductive interconnect in the liquid phase. Accordingly, Applicants submit that independent claim 1 is patentably distinguishable against Tsai.

Dependent claims 2-9 depend from independent claim 1. Insofar as independent claim 1 has been shown to be patentably distinguishable over Tsai, it follows that dependent claims 2-9 are likewise patentably distinguishable.

CONCLUSION

In view of the amendments and remarks set forth herein, the application is believed to be in condition for allowance and a notice to that effect is solicited. Nonetheless, should any issues remain that might be subject to resolution through a telephonic interview, the Examiner is invited to telephone the undersigned at 512-439-5093.

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Mail Stop Amendment, COMMISSIONER FOR PATENTS, P. O. Box 1450, Alexandria, VA 22313-1450, on 7/29/04, 2004.


Attorney for Applicant(s) 7/29/04
Date of Signature

Respectfully submitted,



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